Chemical Reactions Lab

WHAT TO TURN IN: All underlined parts: observations and reactions.

Purpose:

- Observe the five major types of reactions.
- Record observations for these reactions.
- Complete balanced equations for these reactions.

Materials:

EQUIPMENT:
small test tubes
test tube rack
test tube holder (clamp)
crucible tongs
stirring rod
scoopula
Erlenmeyer flask
waste beaker
dropped bottles with various chemicals **
Bunsen burner and flint striker
watch glass
wooden splints
safety glasses

CHEMICALS:
steel wool
copper wool / mesh
magnesium metal
calcium oxide
tap water
distilled water
bromothymol blue indicator
carbon dioxide (from exhaling)
hydrogen peroxide
manganese(IV) oxide
sodium hydrogen carbonate
calcium metal
zinc metal
** hydrochloric acid (3M, 1M, and 0.1 M concentrations)
** lead(II) nitrate (1 M and 0.1 M concentrations)
** sodium carbonate (0.1 M concentration)
** barium nitrate (0.1 M concentration)
** potassium iodide (0.1 M concentration)
calcium carbonate (ground, or chalk pieces)
methane gas (from Bunsen burner)
** ethanol

Section I: Combination (synthesis) reactions A + B → AB
Combination reactions occur when two or more substances come together to form a single new substance.

Reaction 1: Steel wool (containing Fe) combines with oxygen

1. Remove a small piece of steel wool from the wool pad on the lab bench.
2. Pull it apart so that the wool strands are loosely separated.
3. Use crucible tongs to hold the steel wool in the Bunsen burner flame.
4. Record at least two changes observed.
5. Write the complete balanced equation for this reaction. (Fe will form a +3 charge)

Reaction 2: Copper wool combines with oxygen

1. Remove a small piece of copper wool from the wool pad on the lab bench.
2. Pull it apart so that the wool strands are loosely separated.
3. Use crucible tongs to hold the copper wool in the Bunsen burner flame.
4. Record at least two changes observed.
5. Write the complete balanced equation for this reaction. (Cu will form a +1 charge)

Reaction 3: Magnesium combines with oxygen

1. Obtain a piece of magnesium from your teacher.
2. Use crucible tongs to hold the magnesium in the Bunsen burner flame. Be careful not to stare at this reaction.
3. Record at least two changes observed.
4. Write the complete balanced equation for this reaction.

Reaction 4: Combination of calcium oxide and water

1. Place a small amount of calcium oxide into a test tube (about 1-2 cm.) Half-fill the test tube with distilled water and tap the test tube to mix the reactants.
2. Add 5 drops of bromothymol blue indicator to the test tube, and mix by tapping. Bromothymol blue is yellow in acidic and blue in basic solutions.
3. What color were the contents of the test tube after the indicator was added? Does this color indicate an acid or a base?
4. Write a complete balanced equation for this reaction. (Hint: an acid starts with hydrogen ions, a base contains hydroxide ions.)

Reaction 5: Combination of carbon dioxide and water

1. Pour 50 mL of distilled water into an Erlenmeyer flask. Place the flask on white paper.
2. Add 5 drops of bromothymol blue indicator to the flask. (Keep blue colour)
3. Use a straw to blow bubbles into the water indicator mixture.
4. Observe and record the color of the mixture.
5. Your reactants are water and carbon dioxide. What acidic product can you predict for this combination reaction?
6. Give a complete balanced equation for this reaction.

Supplement to Reaction 5:

Note: The general rule for reactions like 4 and 5 is a metal oxide and water produces a base, a nonmetal oxide and water produces an acid. (Acids are usually written beginning with H, and bases are usually written ending in (OH). Use this rule to write equations for the following combination reactions:

1. Aluminum oxide and water
2. Sulfur dioxide and water

Section II: Decomposition reactions AB → A + B

Decomposition reactions result as one substance breaks down to two or more simpler substances.

Reaction 6: Decomposition of hydrogen peroxide (H_2O_2)

1. Place 1-2 cm of hydrogen peroxide into a test tube. Use a test tube holder.
2. Using a scoopula, add a pinch of manganese(IV) oxide as a catalyst for the reaction. Remember, a catalyst is *not* used up in the reaction and its formula is written above the arrow.
3. Place your thumb over the mouth of the test tube to trap the gas. Wait a few minutes.
4. Test the gas that is being given off by placing a glowing splint into the tube. (Light a wooden splint, blow the flame out. If when you place the glowing splint into the tube the flame returns, the presence of oxygen is indicated.)
5. Record observations.
6. Write a complete balanced equation for this reaction.

Reaction 7: Decomposition of sodium hydrogen carbonate ($NaHCO_3$)

1. Place a small amount of sodium hydrogen carbonate into a test tube. Use the test tube holder to grip the test tube and place the test tube into the Bunsen burner flame. Point the mouth of the test tube away from people.
2. Observe the mouth of the test tube for moisture. There are three products of this reaction: carbon dioxide, water and sodium carbonate.
3. Record your observations.
4. Write a complete balanced equation for this reaction.

Test for water with Cobalt Chloride paper

Section III: Single replacement reactions A + BC → AC + B

In this reaction, one substance will replace another substance in the compound.

Reaction 8: Reaction of calcium and water

1. Obtain a piece of calcium from your teacher.
2. Drop the calcium into a test tube 1/3 full of water. Use a test tube holder.
3. Place your thumb over the mouth of the test tube to trap the gas. Wait a few minutes to allow the tube to fill with gas.
4. Test the gas evolved for flammability by using a lighted splint near the mouth of the tube. A pop indicates the presence of hydrogen gas.
5. Add 3 drops of bromothymol blue indicator.
6. Does the color indicate the presence of an acid or a base? What is this product?
7. Check the *activity series* to see if calcium can displace hydrogen in a single replacement reaction.
8. Record your observations.
9. Write a complete balanced equation for this reaction.

Reaction 9: Reaction of zinc and hydrochloric acid

1. Fill a test tube 1/4 full with HC1. (Use the 3M concentration.) Use a test tube holder.
2. Add a piece of zinc.
3. Place your thumb over the mouth of the test tube to trap the gas. Wait a few minutes to allow the tube to fill with gas.
4. Test the gas given off for flammability by using a lit splint near the mouth of the test tube. A pop indicates the presence of hydrogen gas.
5. Check the *activity series* to see if zinc will replace hydrogen in this reaction.
6. Record your observations.
7. Write a complete balanced equation for this reaction.

Reaction 10: Reaction of zinc and ~~lead(II) nitrate~~ $CuCl_2$

1. Place 15 drops of 1M ~~lead(II) nitrate~~ into a test tube.
2. Drop a piece of zinc into the solution; observe any changes you see over five minutes.
3. Check the *activity series* to see if zinc will replace lead in a reaction.
4. Record your observations.
5. Write a complete balanced equation for this reaction.

Section IV: Double replacement reactions AB + CD → AD + CB
In double replacement reactions, the substances are ionized and dissolved in water. The ions are free to move around and find another partner. If the partnership results in a compound which is insoluble in water, a precipitate (a solid) will form. If a gas is formed, you will see bubbles.

Reaction 11: Sodium carbonate reacts with barium nitrate

1. Add 15 drops of 0.1M sodium carbonate to a test tube.
2. Add 15 drops of 0.1M barium nitrate to the tube.
3. Record your observations.
4. Write a complete balanced equation for this reaction.

Check the *solubility table* to identify the insoluble product. Draw an arrow down or use the (s) to indicate the precipitate in this reaction.

Reaction 12: Lead(II) nitrate reacts with potassium iodide

1. Add 15 drops of 0.1M lead (II) nitrate to a test tube.
2. Add 15 drops of 0.1M potassium iodide to the tube.
3. Record your observations.
4. Write a complete balanced equation for this reaction.

Note: Place the yellow solid in a designated waste container as instructed by your teacher.

Reaction 13: Sodium hydrogen carbonate reacts with hydrochloric acid

1. Place about 1 cm of sodium hydrogen carbonate into a test tube.
2. Fill the test tube halfway with 0.1M HCl.
3. Record your observations.
4. Write a complete balanced equation for this reaction.
   Note the "acid" product in this reaction is unstable and breaks down to form carbon dioxide and water.
5. Rewrite your complete balanced equation showing these products.

Omit

Reaction 14: Calcium carbonate reacts with hydrochloric acid

1. Place one small piece of chalk into a test tube.
2. Pour about 10 mL of 1 M HCl into the test tube (1/3 of the way up the tube).
3. Record your observations.
4. Write a complete balanced equation for your reaction.

Note the acid product in this reaction breaks down to form carbon dioxide and water.

5. Rewrite your complete balanced equation showing these products.

Omit

Section V: Complete Combustion of hydrocarbons Hydrocarbon + O_2 → CO_2 + H_2O
When a compound composed of carbon and hydrogen completely burns in the presence of oxygen, carbon dioxide and water are produced.

Reaction 15: The combustion of methane

1. The gas you are burning in the Bunsen burner is methane gas, CH_4.
2. Light the burner and record a description of the flame for your observation.
3. Write a complete balanced equation for this reaction.

Reaction 16: The combustion of ethanol

1. Place 15 drops of ethanol (C_2H_5OH or CH_3CH_2OH) onto a watch glass.
2. Light a wooden splint and place it near the ethanol.
3. Record your observations.
4. Write a complete balanced equation for this reaction.